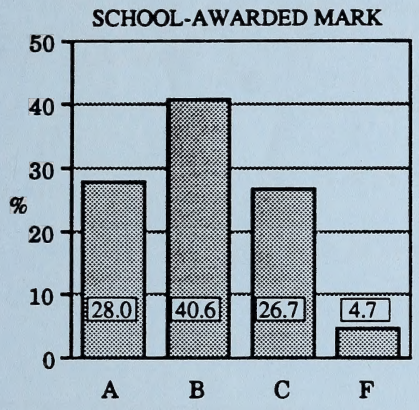
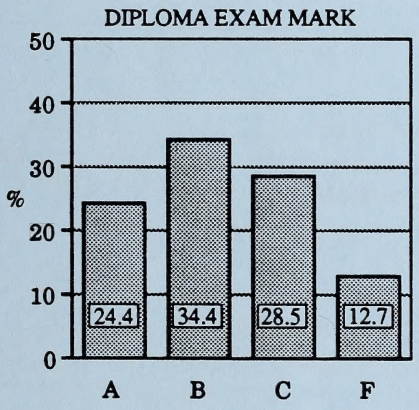
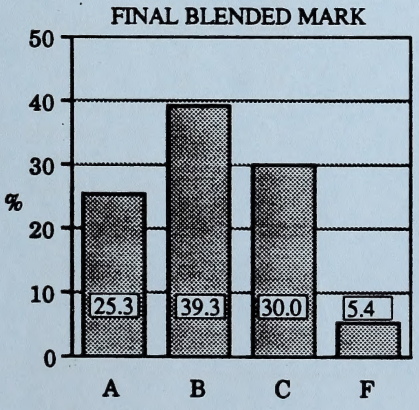
Student Evaluation

Physics 30 Diploma Examination Results







The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the January 1991 administration of the Physics 30 Diploma Examination. The information is most helpful when used in conjunction with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results will be available by the end of 1991.

DESCRIPTION OF THE EXAMINATION

The Physics 30 Diploma Examination consists of two parts: a multiple-choice section of 49 questions worth 70% and a written-response section of four questions worth 30%.

ACHIEVEMENT OF STANDARDS

The information reported is based on the final blended marks achieved by 3 128 students who wrote the January 1991 examination.

- 94.6% of these students achieved the acceptable standard (a final blended mark of 50% or higher).
- 25.3% of these students achieved the standard of excellence (a final blended mark of 80% or higher).

PROVINCIAL AVERAGES

- The average school-awarded mark was 70.7%.
- The average diploma examination mark was 67.7%.
- The average final blended mark, representing an equal weighting of the diploma examination and school-awarded marks, was 69.7%.

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SUBTEST RESULTS

When analysing any detailed examination results, please bear in mind that subtest results **cannot** be directly compared. Results are in average raw scores.

Machine scored: 35.1 out of 49

Written response: 12.3 out of 21

- Course Content
  - Light: 10.2 out of 16
  - Electric and Magnetic Fields: 13.2 out of 19
  - Electromagnetic Radiation: 6.6 out of 10
  - Structure of Matter: 9.8 out of 14
  - Modern Physical Theories: 7.6 out of 11
- Process Skills: 22.9 out of 38
  - Multiple-choice questions 6, 8, 9, 14, 17, 18, 19, 21, 27, 28, 31, 33, 35, 39, 43, 44, and 49; and written-response questions 1, 2, 3, and 4.
- Cognitive Levels
  - Knowledge: 13.2 out of 17
  - Comprehension and Application: 23.9 out of 35
  - Higher Mental Activities: 10.3 out of 18

EXAMINATION BLUEPRINT

Each question on the examination is classified in two ways: according to the curricular content area being tested and according to the cognitive level demanded by the question. The examination blueprint illustrates the distribution of questions in January 1991 according to these classifications. Numbers with square brackets [ ] indicate written-response questions, and those without brackets indicate multiple-choice questions.

Reporting Category	Questions by Cognitive Level			Examination Emphasis (%)
	Knowledge	Comprehension and Application	Higher Mental Activities	
Light	1, 2, 5, 7	3, 4, 6, 8, 9	[4]	23
Electric and Magnetic Fields	10, 13, 15, 24	11, 12, 16, 17, 18, 19, 20, 22, 23, [2]	14, 21	27
Electromagnetic Radiation	25, 26, 32	27, 28, 29, 30, 33, 35	31	14
Structure of Matter	34, 41, 42	36, 37, 38, 40, 43 [1]	39, 44	20
Modern Physical Theories	46, 47, 48	45, 49	[3]	16
Examination Emphasis (%)	24	50	26	100

RESULTS and EXAMINERS' COMMENTS

The examination has a balance of question types and difficulties. It is designed so that students capable of achieving the acceptable standard would obtain a mark of 50% or higher and students achieving the standard of excellence would obtain a mark of 80% or higher.

MULTIPLE CHOICE

QUESTION	KEY	DIFFICULTY*	QUESTION	KEY	DIFFICULTY	QUESTION	KEY	DIFFICULTY
1	A	90.3	18	A	35.5	35	C	68.5
2	C	72.7	19	D	88.5	36	B	46.9
3	C	74.4	20	B	87.7	37	D	75.3
4	B	81.3	21	C	34.9	38	A	70.7
5	B	79.0	22	D	73.0	39	C	65.3
6	A	61.6	23	B	85.9	40	B	75.0
7	B	64.7	24	A	74.6	41	B	61.6
8	D	76.5	25	C	77.9	42	D	75.5
9	C	76.8	26	B	81.5	43	D	48.6
10	D	89.0	27	C	59.7	44	C	77.6
11	C	96.2	28	C	43.3	45	A	71.9
12	D	76.6	29	A	61.2	46	B	79.8
13	B	77.4	30	A	90.7	47	C	75.6
14	C	78.5	31	D	39.4	48	D	79.8
15	A	87.3	32	D	76.9	49	C	62.6
16	D	63.2	33	B	60.3			
17	A	77.4	34	A	77.3			

*Difficulty – percentage of students answering the question correctly

MULTIPLE CHOICE (continued)

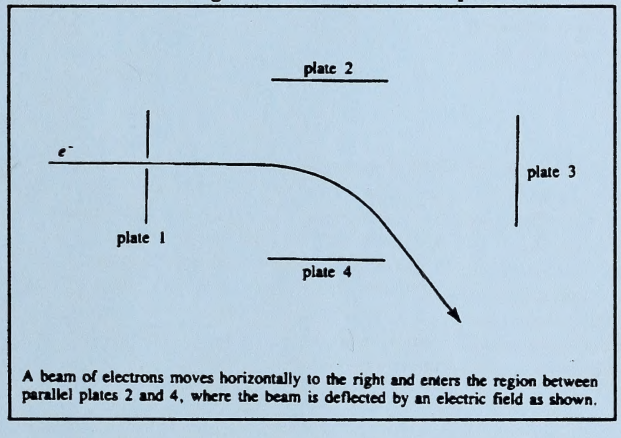
A high level of competence in calculations was expected from all students. Students achieving the standard of excellence were expected to apply knowledge to unusual problems and to use scientific generalizations effectively. Students' performance on the multiple-choice section of the examination was generally satisfactory. As on previous examinations, students found calculation questions the easiest and had the most difficulty with questions demanding the use of unit analysis and vectors. Detailed comments on questions 14 and 18 follow.

14. If a 3.0×10^{-6} C positive charge with a mass of 4.0×10^{-3} kg is released 6.0 cm from a fixed 2.0×10^{-6} C positive charge, the magnitude of its initial acceleration is

A. 1.5×10^{1} m/s^2
B. 2.3×10^{2} m/s^2
* C. 3.7×10^{3} m/s^2
D. 1.3×10^{9} m/s^2

Question 14 tested students' understanding of how Newton's laws are related to Coulomb forces. Students were required to combine two equations from the *Physics Data Booklet* to obtain the answer. Over three-quarters of the students answered this question correctly, including well over half of those whose examination scores were 50% or less. This indicates that teachers can expect lower achieving students to do problems requiring more complex two-step calculations as well as those involving single-step substitution and calculation.

Use the following information to answer question 18.



A beam of electrons moves horizontally to the right and enters the region between parallel plates 2 and 4, where the beam is deflected by an electric field as shown.

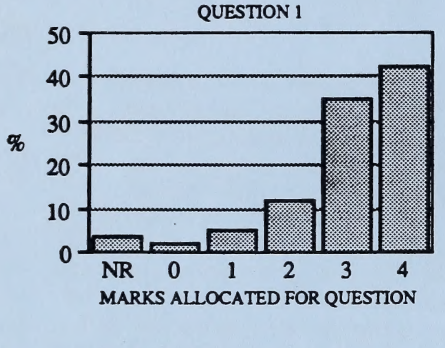
18. The direction of the electric field that causes this vertical deflection is from

* A. plate 4 to plate 2
B. plate 2 to plate 4
C. plate 3 to plate 1
D. plate 1 to plate 3

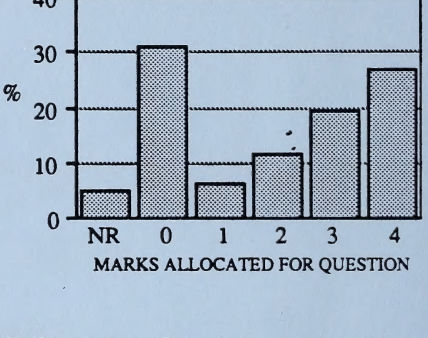
Question 18 required students to understand the interaction between an electric field and a negatively charged particle. The key elements of the interaction were that the electric force was attractive and that the direction of the field was opposite to that of the force. A large proportion of students whose examination scores were 80% or higher were able to answer this question correctly. Most of the students with marks lower than 80% confused the directions of the field and the force, and therefore selected answer B.

WRITTEN RESPONSE

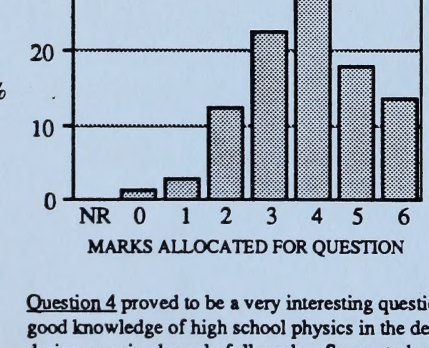
The four questions in the written-response section were created from four of the five strands for Physics 30. Students' problem-solving skills were tested most in question 2, in part b of question 3, and in part b of question 4. Students receiving an examination mark of 50% were expected to get 3 out of a possible 4 marks on question 1. Few of these students were expected to obtain any marks on question 2. However, they were expected to receive half marks on question 3 and 2 out of 7 marks on question 4. Students performing at the standard of excellence were expected to obtain near full marks on questions 1 and 2, and 5 marks on each of questions 3 and 4.



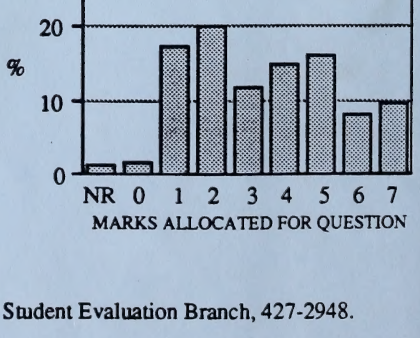
Students performed very well on question 1. Three-quarters of them received a score of 3 or 4 out of a possible 4 marks. Students were able to find a value for the wavelength of light and successfully solve for the kinetic energy of the photoelectrons. Even those students who found an incorrect wavelength were able to use their value correctly to get an answer for photoelectron energy. On this 4-mark question, the average score was 3.03 or 76%.



Question 2 proved very difficult for students achieving at or below the acceptable standard but was answered quite well by the others. Students were required to use the law of conservation of charge twice to determine the magnitude of each of the two charges in terms of the initial charge Z. Students with better algebraic skills gave solutions involving the use of ratios. Other students presented solutions that used hypothetical values for Z and then used the given force to find the corresponding value of R. These values were then used with the new values of charge to calculate the magnitude of the new force. Students also used a hypothetical value for R in the same way. There was a significant number of NO RESPONSES to this question. This can be attributed to students feeling uncomfortable when required to use ratios in an algebraic solution. On this 4-mark question, the average score was 1.96 or 49%.



Question 3 was at least attempted by 99.9% of the students. It required students to graph two quantities correctly and then to use the slope of this graph to find Planck's constant. Most students were able to find a value for the slope, but not all were able to use it correctly. Instead, they assumed that 2.16×10^{-42} kg•m was Planck's constant and did not consider whether their answer was reasonable. A significant number of students did not consider the slope to be a suitable averaging technique. Rather, they chose to find six individual values of h and then found the mean of these values. However, since this method was valid only if the best-fit line on their graph passed through the origin, many students lost marks for this part. On this 6-mark question, the average score was 3.85 or 64%.



Question 4 proved to be a very interesting question to mark. Students demonstrated a very good knowledge of high school physics in the design that they chose. Often the simplest designs received nearly full marks. Some students chose to repeat the experiment as stated while others used concepts only from Physics 30 in their experimental design. The most successful designs included those that excluded the other two hypotheses rather than controlled them. Other successful designs used concepts from Physics 10 and Physics 20. However, approximately one-quarter of the students failed to understand that an experimental design was necessary. These students generally discussed the validity of one of the three hypotheses without ever mentioning an experimental design, and therefore did very poorly on the question, even though they demonstrated a broad knowledge of physical principles. It is important to note that students should not feel restricted to concepts taught at the Physics 30 level on these types of questions. As well, students should be encouraged to use a higher degree of precision in their answers to future discussion-type problems. On this 7-mark question, the average score was 3.47 or 50%.

For further information, contact Craig Emter, Yvonne Johnson, or Phill Campbell at the Student Evaluation Branch, 427-2948.

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